TEXTILE RESEARCH

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IN THIS ISSUE

Gold Lace for the Navy 2

Research and the Patent System 9

Cotton Fiber Strength Study 17

Abstracts 23

Research Activities 8

Research Aids 20

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VOL. XIII **TEXTILE RESEARCH** NO. 9

Outstanding Features in

This Month's Issue

Gold Lace for the Navy

Among the many outstanding achievements induced by war necessity, the development of the manufacture of gold lace, or gold braid and insignia for the U. S. Navy ranks as an accomplishment of importance. For more than three hundred and fifty years the secret of the manufacture of this product has been closely held by the French lace manufacturers of Lyons. (See page 2.)

Research and the Patent System

That all opportunity was lost to the individual inventor a century ago, and that as a consequence progress in general has been retarded has been asserted by some who advocate a revision of the patent laws. (See page 9.)

Cotton Fiber Strength Study

A series of tests was made at the U. S. Department of Agriculture's Stoneville Laboratory in order to determine in a systematic way the extent of the differences between operators and between machines using the Pressley Cotton Fiber Strength Tester. (See page 17.)

Load-Elongation Testing of Fibers

Studies of the mechanical properties of individual textile fibers have been handicapped by lack of a convenient, accurate, and autographic apparatus capable of handling the small forces involved in the stretching of a single fiber. Such an apparatus has been developed as a result of the work of research associates of the Textile Foundation. (See page 20.)

Necessity and Research Give This Country A New Industry—the Manufacture of

Gold Lace for the Navy

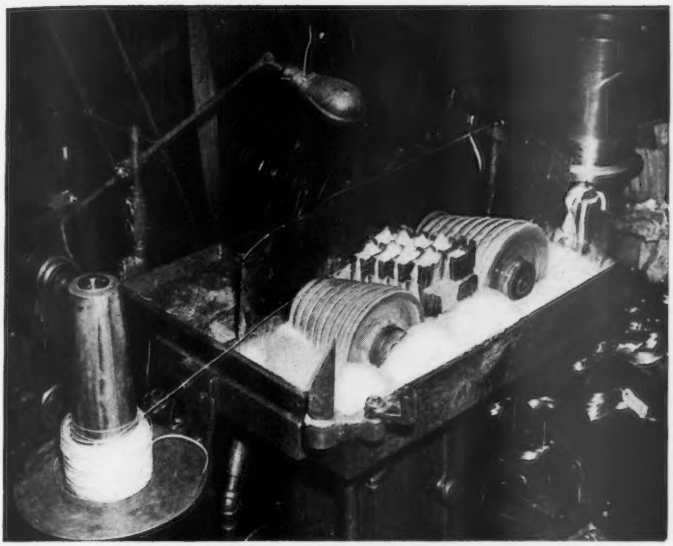
By JULIAN S. JACOBS, EDITOR

AMONG THE NOTABLE BUT UNPUBLICIZED ACCOMPLISHMENTS in connection with our war effort, is the successful development of processes for the manufacture of gold lace for the United States Navy, and the hand embroidered insignia worn by Naval officers. The fall of France cut off the only supply of this product, the manufacture of which had for centuries been a trade secret closely held by the French lace manufacturers of Lyons. Incidentally there were, prior to the war, approximately 50,000 workers in the Lyons area engaged solely in the manufacture of gold lace for the world markets.

The art of making metallic yarns of gold and silver dates back to antiquity and appears to have been introduced by the Assyrians into the Persian area. One type found on the Island of Cyprus had a base of animal membrane. The Persians developed a method by which a pure silver heavily coated with gold was beaten out and drawn to the thickness of a hair, then flattened and spun with a silk core by means of a revolving spindle suspended out of contact with the ground. The ancient Chinese also perfected a method which involved the coating of paper on one side with the metal and then cutting it into strips $\frac{1}{32}$ inch in width. Incidentally, the last two named methods are still in use in northern India.

The abrupt severing of the sources of supply for gold lace caused by the Nazi invasion of France left the Navy wholly dependent on the limited stocks on hand, and odds and ends of material such as tinsel and the like that could be converted to the manufacture of braid and insignia.

The situation having become very critical by the



(Courtesy General Plate Co.)

Fig. 1. One of the intermediate stages in the drawing of gold wire.

winter of 1940, Lt. Comdr. Fulton Rindge * (S. C.), U. S. N. R., undertook to locate a source of supply. A thorough search of all possible sources, such as manufacturers of metal threads, etc., failed to reveal any knowledge of the art. Finally Rindge, deciding that the Providence, R. I., area which is the center for the jewelry industry should have the greatest possibilities, got in touch with Jenks Arnold who was engaged in the manufacture of rubber-covered thread in Pawtucket. A conference was held at the Biltmore Hotel in Providence early in March, 1941, following a fruitless survey of the wire-drawing manufacturers in the area, all of whom said the thing couldn't be done. They stated that gold-filled wire as fine as was required had never been drawn in this country.

Arnold, who is gifted with typical American resourcefulness, and Rindge, who was, as usual, willing to gamble on a long chance, agreed that it should be possible to duplicate or even to improve any product that had been manufactured abroad. *(Continued on page 4.)*

* Fulton Rindge, treasurer: Ware Woolen Co.; Gonic Mfg. Co.; Cocheco Woolen Mfg. Co.; and Hampshire Woolen Co.

General Plate Company in Attleboro, Massachusetts, who are among the largest wire-drawers and manufacturers of gold plate, were induced to participate in the development of a suitable wire. Wire for this purpose must be of a metal sufficiently soft to draw very fine, and because of expense must have a core of cheaper metal than gold. Copper has in some cases been used, but it tarnishes badly and silver has proved to be best.

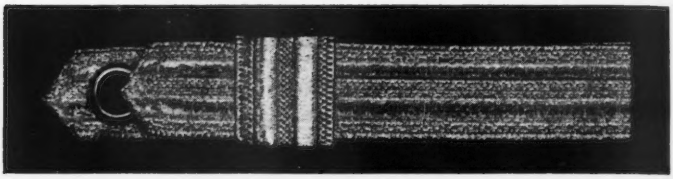


Fig. 2. Section of chin strap for Naval Officers' caps.

Among the principal problems involved were: determining the proper temper of the wire, maintaining correct color under annealing conditions, and securing a uniformly correct diameter. It was evident that a large amount of research would be required to determine the optimum point, which is a term used in the wire-drawing trade indicating workability. Looking at a piece of braid, one hardly realizes the importance of accurate gold color and perfect concentricity to a wire diameter as low as 0.0018. Any very slight irregularity in contour of the wire automatically throws shadings to offset the necessary color and sheen appearance of the braid.

Highly specialized equipment for a delicate, accurate anneal had to be built as one of the very important features of a wire that could be successfully braided.

The Navy Contract

That a record for speed was set in the solution of the problems will be recognized from the fact that by May—less than two months after the conference mentioned—the Navy decided to issue a contract to the Arnold Manufacturing Company, covering the manufacture of 1,000 yards of gold lace. This contract was dated May 28, 1941, and stipulated that the gold thread was to be manufactured according to specifications and to "represent the best efforts of American industry in its endeavor to

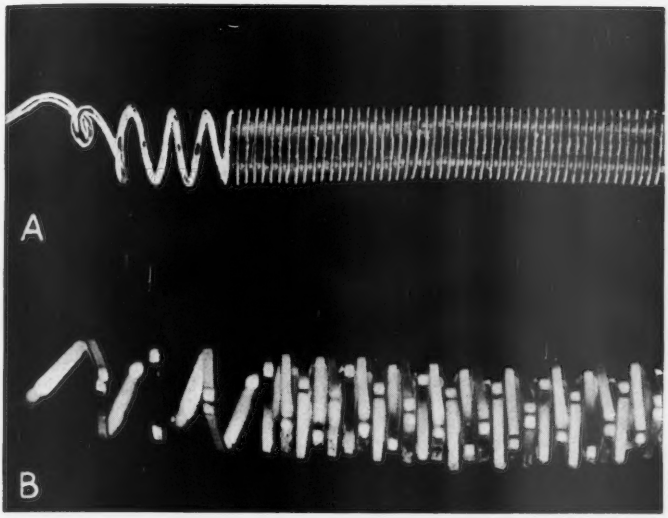


Fig. 3. Gold wire used at Arnold Mfg. Co. in making embroidered insignia. A—coil spring, one end stretched to illustrate convolutions. B—triangular coils. Mag. 12.5 ×.

produce a product not heretofore manufactured in the United States." Incidentally, this was one of the most unusual contracts ever issued by the Navy because many problems still remained unsolved both as regards the wire and the manufacture of the finished product. By June, 1941, some deliveries had been made and accepted by the Navy as fully up to specifications.

All wire used by Arnold for officers' braid and for embroidered insignia is made by a laminated method, inserting a pure silver core approximately 1½ inches in diameter into a shell of pure gold having a wall thickness of approximately ⅛ inch. Both are then bonded together and drawn down to required size. (See Fig. 1.)

Manufacture of Braid

For braid (see Fig. 2), or gold lace as it is called in the trade, the wire has to be flattened, and it proved to be a problem to wrap a silk thread with extremely thin, flattened wire. This was solved by developing two special machines, one of which winds the flat wire evenly on spools, and the other twists it smoothly around a silk thread. The gold thread thus produced is used for the

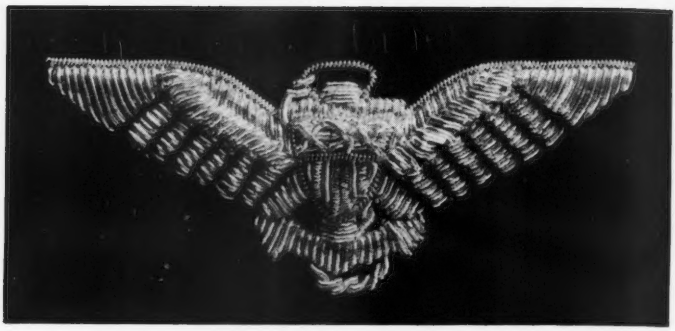


Fig. 4. Naval Air Corps wings—embroidered on Navy flannel.

filling of the lace, and silk yarn is used for the warp. The finished product is made in widths of ⅛, ¼, ½, 1, and 2 inches. The 2 inch braid is used for the Admirals' uniforms and the 1 inch is used for the newly reinstated rank of Commodore.

For the various types of embroidered insignia, the same laminated wire, drawn to 0.0035 is used but it is circular in cross section and not wound with silk. In order to spin this wire into the form of a tightly coiled continuous spring (see Fig. 3), Arnold developed a machine employing, it is believed, an entirely original principle. The machine can be adjusted to deliver the springs with either circular coils, shown in Fig. 3A, or triangular shaped coils, shown in Fig. 3B, the latter, because of the manner in which they reflect light, are used to accentuate certain features of the design.

Embroidered Insignia

In making the insignia, women are employed who cut the springs into short lengths, about 5/16 inch, which are picked up on the point of a threaded needle. The thread is drawn through the fabric and tied on the back, leaving the gold thread on the surface to build the design. A typical embroidered insignia is shown in Fig. 4.

In the embroidering, there are normally employed about 140 women (see Fig. 5), a large proportion of whom have sons or husbands in the armed services and who consider it a patriotic duty, taking great pride in their expertness. Last summer nearly 50 school teachers

appeared and were taken on for the work.

For striping work uniforms and for certain other applications where a less expensive product is suitable, an electro-plated wire is used. For this Arnold devised a novel continuous-process electro-plating machine. This in itself is an important accomplishment, the wire passing through the bath at a rapid and continuous speed, coming out absolutely uniform in color.

Here is a new industry which should persist in the post-war era and make us independent of foreign supplies. A steady improvement has been made in the process since its inception and costs have steadily been lowered. Business is being transacted with foreign governments who are our allies and who have found that they can buy certain widths of gold lace at lower prices than they formerly obtained abroad. The manufacturers state that the domestic product is superior to that of foreign manufacture. This is of direct concern to the American Naval officer, who must buy his own insignia.

Fig. 5. Two grandmothers, 65 and 60, work full time embroidering gold insignia at Arnold Mfg. Co.

(Courtesy Pawtucket Times)

RESEARCH ACTIVITIES

A special report—The Fireproofing of Textiles—recently issued by Textile Research Institute, Inc., is described on page 20 of this issue.

M. Earl Heard has resigned the office of dean of the Philadelphia Textile Institute. He is to be director of research for the West Point Manufacturing Company of West Point, Georgia.

Dr. K. L. Hertel, director of the fiber research laboratory of the University of Tennessee at Knoxville, Tennessee, addressed the American Association of Textile Technologists at the June meeting of the Association held in New York. Dr. Hertel explained the use of the Fibrograph and the Arealometer, in measuring length and fineness, respectively, of the cotton fiber.

It has been announced that the Ford Motor Company has suspended operations on its soy bean fiber development.

Confidential Report No. 12, of the Textile Research Institute's cooperative warp sizing project deals with weaving efficiency in relation to the film properties of sizing materials.

A novel type of multiple yarn is described in U. S. Patent No. 2,313,058 assigned to Sylvania Industrial Corp. The first claim of the patent states: "In a process of making a composite multi-ply yarn, the steps comprise associating a potentially thermoplastic strand with a non-thermoplastic strand by twisting one of said strands about the other, and treating said potentially thermoplastic strand to render said strand adhesive and bond said strands together."

How Patent Protection Encourages Research Is Outlined in Discussion of

Research and the Patent System

Part I.—The Individual Inventor

By H. WICKLIFFE ROSE*

Attacks on the patent laws and proposals for revision of the patent system appear again to have become popular. However, the importance of adequately assuring the element of time required for the development of a new process or a new machine can hardly be overestimated. For this affects not only the individual research worker and inventor but also the continuity of life for the corporate structure.

In "Research and the Patent System," Mr. Rose discusses the workings of the patent system. Part I., which follows, deals mainly with its relationship to the individual inventor, and the question of right of access by the newcomer to the technology in a field fenced off by patent claims. Part II., which will appear in the August issue of TEXTILE RESEARCH, *will discuss "Patents and the Corporation."*

That all opportunity was lost to the individual inventor a century ago, and that as a consequence progress in general has been retarded, has been asserted by some who advocate a revision of the patent laws. Included among the arguments in support of this premise is the statement that the corporation, whose exposure to competition is a constant threat to its security, has, as one means of securing immunity, taken unwarranted advan-

* H. Wickliffe Rose, coordinator of research planning, American Viscose Corporation, Wilmington, Del. Some of the subject matter of this article was given by Mr. Rose in a recent address before the Practising Law Institute in New York.

(Courtesy Smithsonian Institution)

Fig. 1. Model of the Whitney cotton gin, constructed before 1800.

tage of the period of protection permitted under the patent laws. It has been stated that the tendency has been to patent everything in sight in order to block all possible avenues of approach to the development of competing products.

The game of revising the patent laws is not a new one, a compulsory licensing bill having been introduced in Congress as long ago as 1874. A recent attack on the system is contained in Monograph No. 31, "Patents and Free Enterprise" (published only two years ago), of the Temporary National Economic Committee. Although the Monograph is an attack on the patent laws directly, it includes the patent system, the corporation, and much of the economic system in its target. The patent laws have been attacked more vitally by certain rulings of the courts, including the Supreme Court, which have tended to change the laws by precedent rather than by legislation.

As a result of these attacks, there has been aroused in industry, in the law, and even in the laity, an active critical and appraising examination of the subject of patents, the patent act, and patent law. The appointment of the National Patent Planning Committee focused attention on the discussion, and views on every phase considered by the Committee have been expressed, and many published, by men in various positions in industry, in science, and in the legal profession.

Since there is nothing so constant as change, this appraising of the patent laws is to the good. It is democracy at work. When one realizes that the frontiers, by their very nature, have always been rugged, where the survivor must often make his own way, there is small wonder if in the frontiers of industrial science there have been abuses of the patent system.

We should be prepared to modify and improve wherever necessary, but we should save and strengthen whatever is worth having.

It is well to examine the implications in certain court rulings and certain sweeping assertions made in the attacks upon the system, in the light of the facts as revealed in the history of our industrial growth.

Research and Invention

Industrial research, which came into being in this country within our lifetime, and which even so recently as twenty years ago was being advocated, planned, and defended, is today fairly well taken for granted as insurance for the future in a large industrial corporation.

The definition as interpreted by the courts on patent law in recent years, however, makes a distinction between research and invention. There seems to be some difference in the evaluation of a patent which derives from an invention and one which derives from research. One gains the impression that somewhere in the judicial mind there is a picture of research workers burning the midnight oil to copy the works of others, and of tinkers making minor modifications on the devices of others in order to stake out adjacent claims. Of course there are both

aplenty, and in the field of invention and patents, as in every other phase of business, there are those living by their wits at the expense of others rather than through creative effort; but it is hard to believe that the courts do not appreciate research as a source of invention.

As a matter of fact human thought is continuous, in the individual and in the world. Ideas breed ideas, and it is no more possible to have gaps in thought than in the heredity line of a species.

Eli Whitney, one of the country's most famous inventors, was an acknowledged genius, and the cotton gin was a product of genius, but it was no flash. After Mrs. General Nathaniel Greene had suggested to him in Savannah that a fortune awaited the man who developed a device for freeing the lint from the cotton seed, he spent the entire winter secluded in an improvised workshop before the first device was brought forth, and even then the device was not practical until Mrs. Greene, by using her clothes brush to free the lint collected on the cylinder, gave Whitney the idea for a doffing brush which made the apparatus successful.

Nylon, which was certainly a product of genius, was nevertheless brought into being by Carothers in a long series of laborious experiments prompted by a market demand for a fiber that would dye like wool. Nylon is part of a continuity of thought which has been traced all the way back to 1734 when Réaumur wrote, "Silk is only a liquid gum which has been dried; could we not make silk ourselves with gums and resins?"

Research and the Individual Inventor

There are those who bemoan the good old days of the individual inventor. Monograph No. 31 states that the individual inventor lost all opportunity a century ago and that the world is not quite the same without him. As a matter of fact, there are many more individual inventors today than there were at any time in the last century. The statistics of the Patent Office show that in 1932, the record year for patents issued, 26,326 patents were issued to individuals out of a total of 53,500. Although

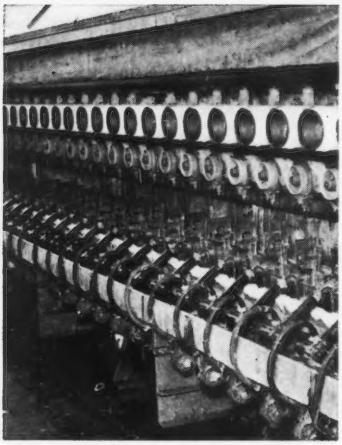
Fig. 2. Topham Box for viscose yarn spinning.

the proportion of patents issued or assigned to corporations has increased rather steadily and the number issued to individuals has fallen off since 1922, the great increase of industrial research is reflected thereby rather than the restriction of opportunity for the individual inventor.

In a recent ruling of the Supreme Court the term "flash of genius" was used to define invention. In Monograph No. 31, the same term is coupled with "accidents" in making a distinction between invention and research. It is obvious, however, that a flash of genius can occur to a man in the course of a laborious research project in a large industrial laboratory, as well as to one alone in a shop in his basement. The "flash of genius" should not be dimmed in the judicial mind by the shadow of the corporation.

Individual inventors have a place in the research and development work of the corporation which I represent. Within the past year or two, several have been employed on contract for full time for a specific project, some for part time on a general project, and some are to offer whatever occurs to them when the spirit moves or genius flashes, or their inventions have been purchased outright or purchased on a share basis. With so many different arrangements possible in one corporation, it becomes obvious that the increase of industrial research has not closed opportunity to the individual inventor.

The work of individual inventors has grown to such an extent that some have formed consulting firms, or



(*Courtesy North American Rayon Co.*)

Fig. 3. Bobbin spinning of viscose rayon.

have hired laboratory assistants and have formed corporations. Such research organizations are used instead of research facilities by small industrial corporations and as extensions of such facilities in large ones.

Time is Required for Commercial Development

There is an implication that, before the patent on a successful industrial invention expires and enters the public domain, the subject is so fenced about with further claims that a newcomer is denied access to the technology. The rayon industry, with its annual world production of nearly three billion pounds, and its 632 million pounds in this country, is clearly a case in which the public interest is being served by inventions which have survived the life of their patents. The fact that less than twenty producers turn out that poundage in this country reflects not a technology fenced by patents, but one that required huge initial capital investment and a specially trained technical staff. Access to disclosures and rights by letters patent is one thing, but producing in continuous supply a quantity and quality of rayon adequate to keeping mills running on the types required in any given season by the trade is another problem. Even within the industry, technique has not become rule-of-thumb but is constantly being improved.

The commercializing of the basic patents covering the processes and production of rayon was not easily accomplished. It took five years to establish commercial production in England following the discoveries of Stearn and Topham at the turn of the century. Of the

seventeen years' life of the patents, to end in 1917, the first five passed before Courtaulds built a plant in England (1905) and the next five before they acquired the United States rights and started a plant here (1910). Thus only seven years remained in which the business could be developed under patent protection in this country.

Courtaulds was not the first to try rayon here. Two unsuccessful attempts to commercialize the Stearn and Topham patents had already been made in the United States. Both attempts failed technically in spite of the fact that, in addition to the patent rights for the United States, the agreement provided the know-how, and a man came from England bringing the technical information which had been acquired up to that time.

The experience here with the commercialization of acetate rayon was similar. Although that process of making rayon was the only one to be patented first in this country, and although a plant to produce it began operations in South Boston before the last war, the operation was not a commercial success until new technique was brought in, again from England, and a new plant was started by another company on a much larger scale.

With the cuprammonium process for making rayon in this country the experience

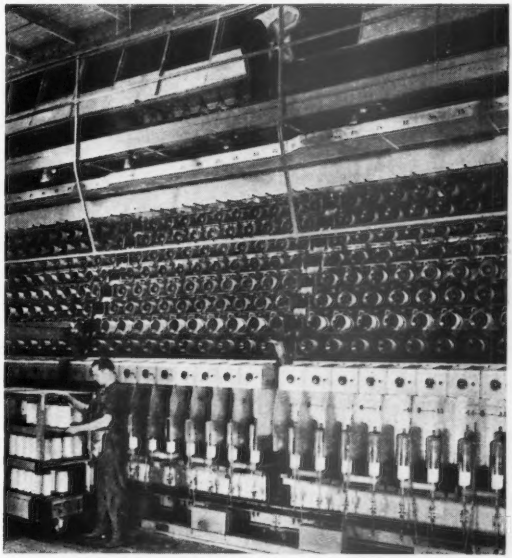


Fig. 4. Latest development—continuous spinning and treating of viscose rayon.

(Courtesy Industrial Rayon Corp.)

was only slightly different. Although the same corporation formed by German interests, using technique brought over from that country, kept the process alive here, it was not financially successful during the early years of its operation. Not until new technique improved the product and lowered the costs did the process become profitable.

The results of making rayon by the cellulose nitrate process were not so happy, even after years of operation, some of which were financially successful. Technology in that process did not keep pace with the trend to higher quality and lower prices in the competing processes, and when a flying squadron of outside organizers entered the plant one night and closed it down, it did not have the strength to survive in these United States. Today it is operating successfully in Brazil.

Access to Disclosures

The conclusions to be drawn from this review of commercialization of the basic patents in the rayon industry are these:

Access to the disclosures and rights of letters patent does not necessarily insure successful operation. A large-scale operation, such as the manufacture of rayon, requires not only a huge stake of capital even for an attempt to start it, but also a faith strong enough to survive the many disappointments which face the investor before the final figure in red turns black.

The complaint of the have-nots, that they are excluded from access to a technology fenced off by patents, springs from assumptions that may be fallacious. They assume that they would be able to raise capital and gain a financial return by operation in an industry already adjusted to the complex stresses and strains of competition; that they would be competent to master the technique had they full access to it; but first they assume that the industry would be there even without the assurance given the investor by the letters patent. The next pasture may look greener, but it would be dangerous to assume that the pasture crop would be there had it not been fenced off during the growing period.

Machine and Operator Variations Measured in

Cotton Fiber Strength Study

A newly developed cotton fiber strength testing machine, known as the Pressley Cotton Fiber Strength Tester, has been found to provide results which are highly correlated with those obtained by the well-known Chandler round-bundle method of determining tensile strength of cotton fibers. The tests on the new machine can be made about 6 to 8 times as rapidly as with the Chandler method, and therefore its adoption is rapidly taking place in various cotton fiber testing laboratories.

The following article briefly summarizes the report of a series of tests conducted at the Stoneville Cotton Testing Laboratory of the U. S. Department of Agriculture. A comparison was made of the results obtained upon a large number of varieties of cotton by different operators using eight different Pressley machines. The complete report can be obtained from the Department.[1]

To MEET THE NEED for a more rapid and simpler method of obtaining the tensile strength of cotton fibers, the Pressley Cotton Fiber Strength Tester was developed.[2] With this device, small bundles or ribbons of fibers, sheared to a uniform length, are inserted in the tester, and a load is applied to each by means of a rolling weight. Readings are taken of the load required to break the ribbons, and the quotient of the breaking load in pounds and

[1] Machine and Operator Variations on the Pressley Cotton Fiber Strength Tester by Jacob V. Shepherd, Junior Cotton Technologist, U. S. Department of Agriculture, Food Distribution Administration, Cotton and Fiber Branch, Washington, D. C.

[2] Developed by Professor E. H. Pressley, University of Arizona.

the weight of the ribbon in milligrams is considered as the strength index for a particular cotton.

Because a large volume of data had been accumulated with the Chandler round-bundle method which expresses fiber strength in terms of thousands of pounds per square inch of material, it was thought desirable to convert the Pressley indexes to round-bundle strengths, if practicable. This was found to be entirely feasible, and a conversion equation was developed which is now in routine use.[3] A high correlation has been found between Pressley index and Chandler strength, and, therefore, the conversion equation makes it possible to express fiber strength, as determined by the Pressley tester, in pounds per square inch.

As more Pressley machines have been put into service and wider experience obtained with them in the laboratories, some variation in results has been found to exist between operators and between machines. It was the purpose of this study, therefore, to determine in a systematic way the extent of the differences between operators and between machines that would be statistically significant. This study also provided data for a further consideration of the relationship between Pressley index and Chandler round-bundle strength.

A series of studies was made at the Department's Stoneville laboratory, involving 4 operators, 8 machines, and 24 varieties of cotton, totaling 7680 breaks. The breaking order was set up in a randomized block with each operator making 10 breaks in each cotton on each of the machines.

The results indicated that there was a statistically significant difference between means for operators and for machines, and observations made during the tests suggested certain precautions for holding these differences down. The average Pressley strength index ranged from 7.24 to 7.58 for the different operators, or a difference on the Chandler strength basis of 3,000 pounds per square inch.

The principal source of discrepancy in the test results

[3] United States Agricultural Marketing Service. Cotton Fiber Testing Service, 1941. (Mimeographed.)

The group of laboratory technicians in the Government laboratory at Stoneville, Mississippi, performing tests described in this report.

is traceable to the manner in which the ribbon is placed between the clamps. The uniform employment of a ribbon ¼ inch in width was found to give the most consistent and accurate results.

When proper precautions are exercised by an experienced operator, fairly consistent results can be obtained.

There was found to be a difference in results obtained during morning and afternoon testing: the tests in the morning showing a higher average index than those in the afternoon. So far, the discrepancies between the morning and afternoon testing have not been explained.

[The designer of the tester has reported [4] that a total of 100 bundles broken between the hours of 8:15 and 9:30 A.M. on five consecutive days, gave a mean index 0.255 lb. higher than another 100 samples drawn from the same bundles on the same days between the hours of 1:15 and 2:30 P.M. During the test period the temperature and humidity were held under uniform control—Editor.]

[4] A Cotton Fiber Strength Tester. E. H. Pressley, *A.S.T.M.* Bulletin No. 118, p. 13–17 (Oct. 1942).

RESEARCH AIDS

Fireproofing of Textiles*

THE fireproofing of textiles is the subject of a research report prepared by the research information service of the Textile Research Institute, Inc., and recently issued to its members by the Institute.

The object of the so-called fireproof finish for textiles is to render them difficult to ignite and to cause them to feed the flame so inefficiently that it is spontaneously extinguished when the igniting flame is removed, without exhibiting prolonged glowing.

The theory and practice of fireproofing as applied to textiles are discussed and examples are cited from the experience of various authorities. Materials generally used to render textiles fireproof are described, together with methods for their application. Also included is a brief outline of methods for testing fireproofed fabrics.

Tables are included: one classifies recent patents involving organic materials; one lists the percentage by weight of various compounds in a cotton fabric necessary to prevent flame propagation; and another gives a comparison of details of test methods.

As a guide to the literature on the fireproofing of fabrics the selected bibliography will be of special value. References are classified as follows: Patents; Materials and Methods; Testing; Reviews; Trade Literature; and Miscellaneous.

* THE FIREPROOFING OF TEXTILES. *Textile Research Institute, Inc., 10 East 40th St., New York 16, N. Y.* 15 pages. Price to non-members of the Institute, $1.00.

Load-Elongation Testing of Fibers*

STUDIES OF THE ELONGATION OF SINGLE FIBERS under loadings, and the recovery therefrom, reveal much in regard to the potential performance of yarns and consequently of fabrics under service conditions. An important factor contributing to recent progress in the engineering of

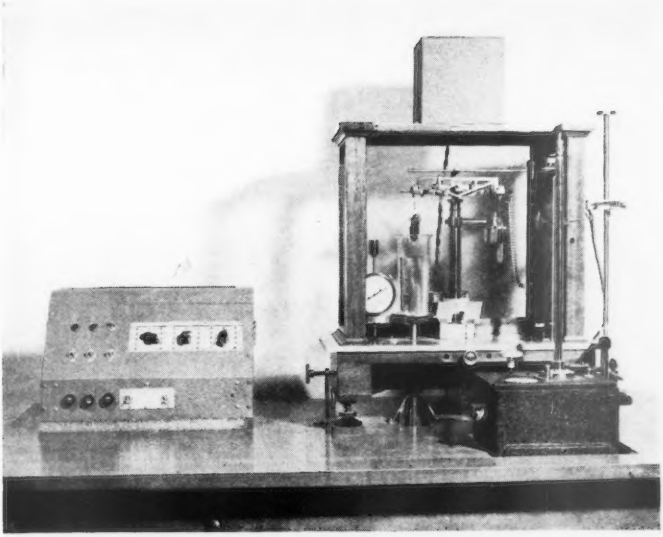


Fig. 1. General view of autographic load-elongation apparatus with recording chart removed.

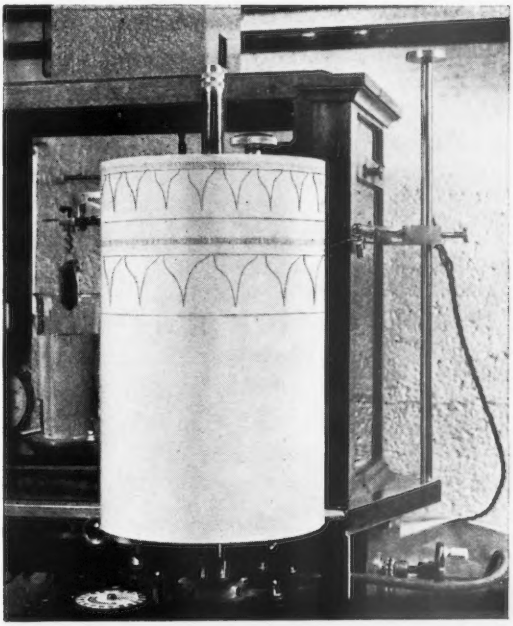


Fig. 2. Autographic load-elongation apparatus with recording chart.

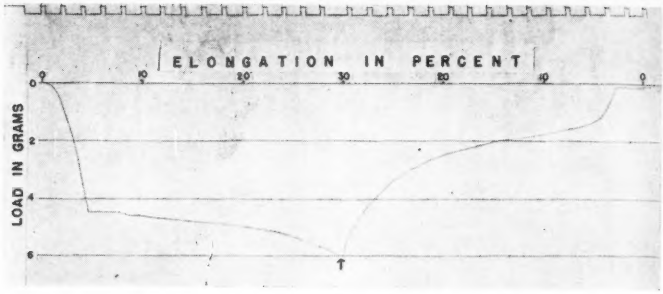


Fig. 3. Load-elongation curve for a wool fiber, elongated at a constant rate in water.

yarns and fabrics, for specific purposes, has been a better knowledge of the mechanical properties of individual fibers. In particular the load-elongation characteristics of single textile fibers have been studied to great advantage.

However, these studies have been hampered by the lack of a convenient, accurate, and autographic apparatus capable of handling the small forces involved in the stretching of a single fiber. Recent work of Research Associates of the Textile Foundation at the National Bureau of Standards has led to the development of an apparatus which meets these requirements. It is adapted to making a continuous load-elongation record at constant rate of elongation, and to making a point by point record at constant rate of loading. It is also useful for obtaining relaxation curves for single fibers. The range of the instrument is sufficiently great so that all of the natural or synthetic fibers can be studied. Sensitive autographic operation is attained by means of photoelectric controls, and automatic recording in rectangular coordinates is provided. Examples are given of the performances of the apparatus.

The complete description of this apparatus is being published currently in *Journal of Research,* National Bureau of Standards.

* Autographic Load-Elongation Apparatus for Fibers. By Arnold M. Sookne and Henry A. Rutherford, Research Associates of the Textile Foundation at the National Bureau of Standards, Washington, D. C.

ABSTRACTS

ANALYSIS: TESTING: LABORATORY METHODS

Adipic Acid

Adipic acid: a review. H. Peters. *Text. Colorist* **65**, 96, 139 (March 1943).

Adipic acid $(CH_2)_4(COOH)_2$ which is polymerized with hexamethylene diamine in the manuf. of nylon, is synthesized by the oxidation of cyclohexanol. Either HNO_3 in the presence of Hg or V, or air at high temp. and pressure will effect this oxidation. Adipic acid consists of colorless or yellowish needles melting at 149° C. It is slightly sol. in H_2O, but more sol. in alcohol and ether. It decomposes when strongly heated to yield carbon, tar, and gases, while under less drastic heating CO_2 is lost and cyclopentanone is formed which on prolonged heating yields a resinous product. Besides its use in the manuf. of nylon, adipic acid finds important uses in dyeing, printing, and finishing.

Separation of Fatty Acids

Colored chromatograms with higher fatty acids. Morris M. Graff and Evald L. Skau. *Ind. Eng. Chem. Anal. Ed.* **15**, 340–1 (May 1943).

A method has been described for sepg. mixtures of higher fatty acids by Tswett adsorption analysis, whereby sepn. into zones was observed on a column of heavy MgO impregnated with a suitable indicator. The fatty acids were recovered by dissolving the MgO in particular sections of the column in acid and extracting with ether. By this procedure it was possible to demonstrate a sepn. of an unsatd. fatty acid from a satd. fatty acid of the same no. of carbon atoms and of two satd. fatty acids differing in chain length by four carbon atoms.

Carbohydrate Acetates

Quantitative estimation of acetyl in carbohydrate acetates. Roy L. Whistler and Allene Jeanes. *Ind. Eng. Chem. Anal. Ed.* **15**, 317–8 (May 1943).

A method is reported for the quant. estimation of acetyl in either polysaccharide acetates or simple sugar acetates. The acetates are transesterified by sodium methoxide catalyst in anhydrous methanol to yield methyl acetate, which is quant. distilled, and saponified in standard alkali. The method is rapid, gives reproducible results, and possesses the advantage of yielding acetyl values which are not affected by the presence of non-volatile acidic groups in the sample.

Determining Damage Caused by Fungi

Determining the deterioration of cellulose caused by fungi. Improvements in methods. Glenn A. Greathouse, Dorothea E. Klemme, and H. D. Barker. *Text. Colorist* **65**, 168–75 (Apr. 1943). *Ind. Eng. Chem. Anal. Ed.* **14**, 614–20 (Aug. 1942). TEXTILE RESEARCH (abridgement) **12**, 13–16 (Aug. 1942.)

A standardized quant. method for the evaluation of the ability of fungi to decompose cellulose is described. Certain features of this procedure may also prove useful in developing a standardized method for testing rot-proof treatments for fabrics. This technique, employing glass fabric and liquid nutrient instead of solid mineral agar, possesses advantages with respect to accuracy and speed over previously reported methods. Provision for uniform aeration of culture chambers is highly important, especially in reducing sampling error variability. *Metar-*

rhizinm sp. and *Chaetomium globosum* cause very rapid decomposition, are easily handled, and have other features that make them satisfactory test organisms. They are definitely superior to *Chaetomium elatum, Alternaria* sp., *Hormodendrum* sp., and *Stachybotrys papyrogena*. NH_4NO_3 was found to be a better source of N_2 than $NaNO_3$ for the development of most of the fungi. The pH of the substrate appears to have an important influence on the activity of cellulose-destroying fungi.

Cellulose Esters

Estimation of volatile acyl groups in cellulose esters. F. B. Cramer, T. S. Gardner, and C. B. Purves. *Ind. Eng. Chem. Anal. Ed.* **15**, 319–20 (May 1943).

The acyl groups from the cellulose ester are recovered as methyl esters by a transesterification in methanol, with sodium methylate followed by excess p-toluenesulfonic acid as catalysts. Since the lower methyl esters are more volatile in methanol than the free acids are in steam, a short distn., instead of the rather tedious one characteristic of the Ost process, transfers the esters to the distillate. This distillate is trapped in an excess of standard aq. alkali. Saponification, removal of excess methanol by distn., and titration of the residual aq. soln. complete the estn.

Hydrolysis of Cellulose

The hydrolysis of cellulose in phosphoric acid solution. Bailli Nilssen. *Tids. Kjemi Bergvesen* **20**, 123 (1940); *Chem. Zentr.* **1941, I**, 1811 (through *Chem. Abstr.* 1943, **37**, 2927[7]).

Analogous formulas have previously been used for the calcn. of the hydrolysis consts. from the viscosity and from the amt. of terminal groups. Nevertheless, a larger mean mol. wt. has been obtained on the basis of viscosity detns. than by terminal-group detn. The viscosity formula previously used has been modified to bring the results into agreement with those of the terminal-group method. The modified formula gives hydrolysis consts. more than double those previously obtained.

Color-Fastness Standards

Report of Committee on Group M (A.A.T.C.C.)—Fastness to washing of dyed and printed manufactured organic fibers. Daniel P. Knowland. *Am. Dyestuff Reptr.* **32**, 248–50 (May 24, 1943).

For the determination of the fastness properties of dyed rayon the cotton standards are found inadequate. The standards recommended for rayon are: 1½% Artificial Silk Black G (PR 16), 4% Primuline Conc. (C. I. 812) diazatized and developed with Naphthol AS, and 2% Vat Blue 2BD 100% powd. (C. I. 1184). Full directions are given for dyeing rayon in these three shades. The use of these standards in the evaluation of color fastness is described.

Testing Burst Resistance

Fundamentals of testing the burst resistance of fabrics. III, IV. H. Sommer. *Melliand Textilber.* **22**, 516–20, 564–70 (1941); *Chem. Zentr.* **1942, I**, 953 (through *Chem. Abstr.* 1943, **37**, 2586[3]).

Curves and tables show the influence of surface area of the sample, relationship between tenacity and elongation, the stress-strain relationship in burst tests, a comparison between burst and tenacity values, and examples of the appropriate applications of the results of burst tests. Tenacity tests on strips give results which are too low because the lateral contraction and uneven distribution of stresses are more pronounced than in the burst test. The necessary calcns. and the use of burst tests in

evaluating material for various performance purposes are described.

Measurement of Substantivity

The measurement of substantivity. Oskar Leupin. *Melliand Textilber.* **22**, 635–7 (1941); *Chem. Zentr.* **1942, I**, 1813, (through *Chem. Abstr.* 1943, **37**, 2939[10]).

Substantivity is defined. A quant. formula and app. for its measurement are described. When cotton dyed with a substantive color is repeatedly washed the concn. of dye in successive wash liquors decreases according to a simple exponential function. If concn. of dye in the wash liquor is plotted as abscissas against quantity of wash liquor used as ordinates, an exponential curve is obtained. The quantity of dye originally present on the goods is proportional to the area bounded by this curve and the coördinate axes. The quantity of wash water necessary to reduce the dye strength by one-half is used in giving results of tests.

CHEMICAL AND PHYSICAL RESEARCH

Improvement of Acetylcellulose

The structure and properties of cellulose and its esters. XIX. Methods for raising the stability of acetylcellulose films at low temperatures. Z. A. Rogovin and Z. Ivanova. *J. Applied Chem.* (U.S.S.R.) **14**, 834–42 (1941) (French summary); cf. *C. A.* **35**, 8287[4] (through *Chem. Abstr.* 1943, **37**, 2572[3]).

The methods for improving stability of acetylcellulose films at low temps. (−50°) without plasticization were studied. On lowering the temp., the films show increased tensile strength, decreased elongation and sharply decreased flexular strength. The fragility to flexure can be improved by the use of homogeneous acetylcellulose of high mol. wt. free of fractions of low mol. wt.; use of more concd. solns. for film deposition is also helpful. Films so prepd. even at −50° approach the elasticity of usual films at 20°.

Cellulose in Formaldehyde

The reaction between cellulose and formaldehyde. II. K. Götze and A. Reiff. *Zellwolle, Kunstseide, Seide* **46**, 331–5 (1941); *Chem. Zentr.* **1942, I**, 292 (through *Chem. Abstr.* 1943, **37**, 2570[6]).

In cellulose fiber treated with HCHO (**I**), the **I** becomes partly chemically combined and partly polymerized. Both types can be sepd. nearly completely by extn. for 5 hrs. with 10% NaOH. With the amts. of catalyst held const., and with increasing concns. of **I**, the fiber takes up larger amts. of **I**, particularly larger amts. of the combined **I**. If the **I** concn. is held const., the amt. absorbed can be increased also by increasing the amt. of the catalyst; this promotes greatly the extent of the polymerization. For practical purposes it is more advantageous to raise the **I** concn., as the catalyst may cause other reactions. The swelling power of the treated fiber is lessened in an increasing degree with increasing amts. of **I** absorbed, but not in direct proportion. Above a **I** concn. in the fiber of approx. 1%, the lessening of the swelling power becomes insignificant. The various types of cellulose absorb varying amts. of **I** and, consequently, the effect on the swelling power differs. Amts. of only 0.2–0.5% **I** lower the swelling power of hydrated cellulose sufficiently for practical purposes. **I** reacts with pure alpha-cellulose as well as with contaminations of the carbohydrate type present in the fiber. During normal washing operations, very little **I** is dissolved from the fiber; however, much of the polymerized **I** is dissolved. It is concluded that the decrease in swelling is caused by the

formation of oxymethylene bridges between neighboring cellulose chains. Data are given on the detn. of **I** in the treated fiber.

Damage by Enzymes

Studies of the damaging action of microörganisms on differently oriented synthetic textile fibers. Klara Schönleber. *Zellwolle, Kunstseide, Seide* **46**, 336–42, 386–99 (1941); *Chem. Zentr.* **1942, I,** 1324 (through *Chem. Abstr.* 1943, **37**, 2941[9]).

Under different atm. humidities, temps. and light conditions, acetate, cuprammonium and viscose staple rayons were examd. for their resistance against bacteria and fungi. The orientation of the rows of the micelles parallel to the longitudinal axis of the fiber (produced by the spinning process) gives the fiber greatly increased resistance against the penetration of cellulose-dissolving enzymes. The resistance of cuprammonium staple rayons and rayons is attributed to residual small amts. of Cu which still adhere to the fiber. Cellulose fibers are destroyed chiefly by fungi (*Aspergillus* and *Penicillium*) and less by bacteria; casein fibers are destroyed less by fungi and chiefly by bacteria (*Proteus vulgaris* and *Micrococcus* spp.). Most resistant against bacteria are the fibers of the ester type; viscose staple rayons are also very resistant. The casein fibers offer the least resistance. Bleached fibers are more resistant than unbleached fibers. The addn. of org. compds. in general lowers the resistance against microbes and gives the bacteria good conditions for growth. Even if enzymic influences are excluded, light exerts a damaging influence on the cellulose of synthetic fibers. The extent of the degradation of the fiber could not be measured numerically by technological tests. Numerous photomicrographs are shown.

Structure of Protein

The structure of the protein molecule. D. G. Dervishian. *J. Chem. Phys.* **11**, 236–46 (May 1943).

A two-dimensional double layer of amino acids is postulated as the constitution of proteins in soln. From the known size of a single amino acid residue, the shape and size of a protein mol. of M. W. class 3500 may be estd. The denatured mols. are postulated to have a filamentous or fibrous form characterized by the polypeptide chain. The evidence for such a postulate is reviewed.

DYEING: BLEACHING: FINISHING

Prevention of Damage

Damages in cotton fabrics during dyeing, bleaching and printing. Theo. Schickl. *Klepzig's Textil-Z.* **44**, 918 (1941); *Chem. Zentr.* **1942, I,** 421 (through *Chem. Abstr.* 1943, **37**, 2581[7]).

Acid hypochlorite solns., in consequence of the presence of free HClO, are more reactive than alk. solns. Traces of acid in the finished goods are harmful, particularly if traces of metallic salts are present. Thus in cotton printing, aniline black damages cotton because of the presence of chlorate and HCl. It is recommended to use hypochlorite solns. as thick liquids on printing machines. Treatments with hypochlorite solns. should be followed by a treatment with weak $Na_2S_2O_3$ soln. and the rinsing bath should contain 1.5% Igepon T.

Prevention of Defects

The prevention of defects in piece-dyed textiles. Max Gerards. *Monatschr. Textil-Ind.* **56**, 224-5 (1941); *Chem. Zentr.* **1942, I,** 421 (through *Chem. Abstr.* 1943, **37**, 2580[6]).

Information is given on avoidance of

damages due to rust, to spots from dyes and drops of liquids and to shrinking of piece goods during dyeing; various precautionary measures are recommended for the treatment of carbonized, white piece goods.

Dyeing Casein Fiber

The casein fiber and its dyeing qualities. Richard Kahl. *Monatschr. Textil-Ind.* **56**, Fachheft III, 59–62 (1941); *Chem. Zentr.* **1942, I,** 1560 (through *Chem. Abstr.* 1943, **37**, 2939[4]).

The fulling-proof acid dyes, as the Palatine Fast, Metachrome, Afterchrome, Helindon, Immedial and Immedial leuco dyes, are of practical importance. The dyeing of loose fibers and machine dyeing are discussed, and directions are given for the use of the various types of dyes. In order to bring out the feel of the casein fiber the dyed material must be freed from water as much as possible before it is dried and the drying operation must be carried out at moderate temps.

Dyeing of Grasses

The dyeing of natural grasses. G. Frische. *Deut. Färber-Ztg.* **77**, 467 (1941); *Chem. Zentr.* **1942, I,** 1055–6 (through *Chem. Abstr.* 1943, **37**, 2581[2]).

Grasses which are naturally light in color are placed in dye solns. contg. a little $CaCl_2$ until the desired color tone has been reached. In order to give a lighter color to grasses, they are immersed in a mixt. of alc., turpentine or CCl_4 and then exposed to sunlight. If necessary, they are treated afterwards with NaOH soln. after rinsing and then bleached with $KMnO_4$ and SO_2, $NaHSO_3$ or Cl. The dyeing is effected mostly with basic dyes; if the goods can be dyed only with difficulty they should be treated first with tannin-tartar emetic or Katanol. They can be dyed also with some acid dyes in rather concd. hot baths contg. alum, free from Fe. In order to render them soft and shiny they are after-treated with glycerol or $CaCl_2$ and dried without rinsing.

Stripping of Vat Colors

The stripping of vat dyeings. W. Strobel. *Deut. Färber-Ztg.* **77**, 457–8 (1941); *Chem. Zentr.* **1942, I,** 1430–1 (through *Chem. Abstr.* 1943, **37**, 2939[6]).

Vat dyeings can be stripped only incompletely in the "blind" vat, i.e., the vat charged only with alkali and hyposulfite. The use of a dispersing agent is necessary which facilitates the soln. of the dye particle from the fiber. Peregal is a suitable dispersing agent. A wetting agent, such as Nekal, must not be used. The action of Peregal can be strengthened by the addn. of $MgSO_4$ and Leukotrop W.

Wool Dyeing

Modern theory and practice of wool dyeing. Part X. The Nealon (S.C.I.) and Palatine Fast (I.G.) Colours. C. L. Bird. *Text. Recorder* **60**, 32–5 (Apr. 1943).

Sol. dye lakes are now available for application to wool. They are applied from an acid dyebath and combine the ease of application and levelness of acid dyes with the fastness of chrome dyes.

Wool Dyeing

Dyeing wool with Indigosol O in Esser's apparatus. V. Khokhin. *Sherstyanoe Delo* **19**, No. 3–4, 32 (1940); *Chimie & Industrie* **44**, 432 (1940) (through *Chem. Abstr.* 1943, **37**, 2580[8]).

The first bath, heated at the start to 35–40°, contains 3% Indigosol, 10% Glauber's salt, 3% of 30% AcOH and 1% Rongalite, on the wt. of the

fiber; the bath is brought to a boil in 45–50 min., and held at that temp. for 30 min. Developing is carried out in a 2nd bath (at 25–30°) contg. 7 g. of 60° Be. H_2SO_4 per l.; after 10 min. 1% of $NaNO_2$ is added. A sky-blue color with a slightly greenish shade is thus obtained.

Prevention of Odors

The possibility of forming methylamines in the use of synthetic (textile) finishes. H. Rath, Heinz Georgi and Marietherese Dettinger. *Melliand Textilber.* **22**, 477–8 (1941); *Chem. Zentr.* **1942, I**, 288 (through *Chem. Abstr.* 1943, **37**, 2586[6]).

Goods finished with urea-CH_2O condensates occasionally develop a difficultly removable fishy odor due to methylamines, especially trimethylamine. NH_4^+ ion is necessary for their formation. This can result from high condensation temps., too long a time of condensation, excess CH_2O and low acidity. Odor develops only when the bases are set free, e.g., by hydrolysis, which is increased by heat and moisture and by having the goods neutral in reaction. To decomp. the methylamine salts in the finished goods it is recommended that they be given a weak Na_2CO_3 wash in the presence of an emulsifying agent, followed by a thorough rinsing.

Sizing Rayon Ribbons

The sizing of viscose-rayon ribbons with urea-aldehyde resins. G. F. Rumyantseva. *Byull. Ivanov. Nauch.-Issledovatel. Tekstil. Inst.* **15**, No. 5–6, 432–42 (1940); *Khim. Referat. Zhur.* **4**, No. 1, 131 (1941) (through *Chem. Abstr.* 1943, **37**, 2940[6]).

It is recommended to treat viscose ribbon with an 8% soln. of aldehyde-urea resin prepd. by adding borax 1 g. and urea 16 g. to 40 g. of neutral 40% formalin, heating to 40°, letting it stand for 16–18 hrs. at room temp. and bringing the condensate by means of $(NH_4)_2SO_4$ to pH 6.6. The sizing is effected at a steam pressure of 1.3 atm., and the ribbon is then passed through a drying drum at steam pressures of 2.0–2.5 atm. for 7 min., and finished in the calender. The ribbon thus treated resembles natural silk.

Treatments for Wool

The acid and alkaline treatment of wool. Herbert Brandenburger. *Wollen-u. Leinen-Ind.* **61**, 343–4, 357–8 (1941); *Chem. Zentr.* **1942, I**, 1200 (through *Chem. Abstr.* 1943, **37**, 2940[3]).

Studies of the structure and the chem. properties of the woolen fiber are discussed. Care must be taken to protect the surface flake layer and not to remove the capillary fats. At present the acid washing of wool seems to be the best process. The modern oiling agents, as Spirazol, Servital and Olinor, do not require any alk. wash later for their removal. Furthermore, it is not necessary to employ fulling agents derived from fats or lubricating agents; the only necessary requirement is favorable swelling. Woolen piece goods can now be washed at low pH values of 6–8. For dyeing with Cr dyes, much better products and procedures have been developed. Full details are given on the dyeing of wool in the presence of staple rayon, on mothproofing, on rinsing and on drying of goods.

FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

Effect of Alkalies

The change in textile fibers caused by alkalies. H. J. Henk. *Deut. Textilwirt.* **8**, No. 18, 32–3 (1941); *Chem. Zentr.* **1942, I**, 131 (through *Chem. Abstr.* 1943, **37**, 2582[2]).

A description of the effect of alkalies

on wool and staple rayon and methods used to protect textile fibers against action.

Cleaning Cotton Fiber

Cleaning cotton at the gin. M. A. Goldman and Beardsley Lawrence. *Textile Research,* **13,** 2–6 (May 1943).

Cotton fiber, undamaged, and free from foreign matter can now be automatically produced at the gin by means of a newly developed machine attached to the lint duct. It will deliver the fiber into high-density packages in such form as not to require special breaking or opening machinery at the mill. With an experimental machine a perfect separation was obtained, and it was found possible to remove all foreign matter and to deliver an absolutely clean product, with no loss of usable fiber, in the process. It was even found possible to control the proportion of short fiber if desired. This method of elimination of the foreign matter causes no damage to the cotton fiber. Magnetic traps reduce the fire hazard. The new machine condenses and delivers the fiber in a sliver about one inch diameter, uniformly dense and with a very slight twist, coiled into a cylindrical container about 18 by 36 inches, and compressed to a density of 40 to 50 pounds per cubic foot into a 250 pound package. Plans are being developed for the construction and operation of a full scale unit that will be put into operation at some gin to operate on this year's crop.

Yarn Strength Factors

Yarn strength factors. Easily forgotten but important facts reviewed briefly for cotton mill men. E. H. Helliwell. *Textile World,* **93,** 74–75 (May 1943).

Strength of yarn is more than ever an important factor in current textile requirements. The purpose of this article is to present in condensed form the more important factors affecting yarn strength that have been accumulated through years of practical experience and research. The important fiber characteristics affecting yarn strength are: fiber length, fineness or diameter, spirality or convolutions per unit length, body or springiness, strength, and maturity. Yarn strength depends on number of fibers in its cross-section, the length of these fibers, and how firmly they are held together by the twist. Fiber strength may vary somewhat without weakening the yarn. Yarn breaks mostly because of fiber slippage. Only few fibers are fractured when yarn is broken. Modern developments in fiber binding demonstrate that greater use of fiber strength is possible without sacrificing yarn elasticity. Variations in fiber length uniformity often account for loss in yarn strength, other factors remaining constant. Necessary precautions in the carding process are detailed. Data obtained from Government tests made on the effect of fiber twist on yarn strength show up the discrepancy between the actual and the theoretical minimum twist multiple as a factor of safety to offset possible variations in staple quality, yarn number or atmospheric conditions. Fiber control is impossible without proper temperature and humidity control.

Yarn Strength

Serigraph tests for yarn strength. George West. *Textile World,* **93,** 88–89 (May 1943).

For several years, leading textile testing authorities have gone on record against the reliableness of skein or lea testing. Two factors, namely, slippage of yarn and varying lengths of the loops reeled play a critical part in the elongation. These factors are of such importance that they should replace the use of the skein

method for measuring the quantity of elongation because it measures the evening out of the skein at the same time. Other errors in skein testing may occur in reeling, because of the difficulty of getting an even skein. When the loops are of different lengths the tight loops are the first to feel the stress during testing and frequently reach the point of breaking before the longer loops. Another difficulty is in transferring the skein from the reel, undisturbed, onto the breaking machine. Experiments carried out in the laboratories of American Thread Company on the theory of evening out the yarn loops indicated an average increase in strength of 6% by the serigraph method over the same yarn when tested according to the method prescribed by A.S.T.M. Standards; that is, by taking one turn around the guide. The National Bureau of Standards (Research Paper No. 61) suggests methods of handling a skein that give a break much closer to the sum of the single-strand breaks than is the break obtained in using a lea skein. However, it is believed that the serigraph type of test will give a closer figure than does the skein test. The serigraph test is not subject to the faults of the skein test. If the skein is reeled under light tension and the ends are gummed, it is almost impossible to get an unreliable break. There is little chance of the strands becoming crossed and there is no evening out of the strands. Since there is no strand slippage, the elongation is reliable. The error of inertia which is present in a lea test is reduced. Only ⅙ of the yarn is required when the lea test is used.

Causes of Skin Irritation from Wool

Tickle in wool knit goods. A partial answer to the question of why some fabrics cause skin irritation. Alfred F. Barker, F.T.I. *Textile World,* **93,** 90–91 (May 1943).

The possible causes of tickle in woolen goods are three: (1) the inherent chemical characteristics of wool; (2) the coarseness of wool fiber; (3) the coarseness of the knit goods texture. Possible subsidiary causes are: warmth of the fabric (doubtful or of minor importance), protrusion of uncontrolled wool fibers in heterogeneous yarns, and tautness and direction of fiber twist in yarn. Studies indicate that differences in degree of tickle must be sought for in the structure of fiber, yarn or fabric. The following experimental approaches are suggested: tests of the effects of various-weight fabrics made from known non-tickle yarn in a non-tickle structure on tickle-sensitive persons; tests for tickle ply yarns of wool and cotton against blended yarns; tests on worsted yarns both as to fiber twist angle and direction; tests to prove or disprove the assumption that larger-diameter wool fibers produce greater tickle effects; tests to determine how far the blending of cotton with wool will suppress tickle. Factors relevant to such investigations are the electrical properties of wool, the effect of treatment with chemicals, and the plating of tickle fabrics with a layer of non-tickle fabric. Suggestive analytical tables are given.

Service Tests on Hosiery

A service study of women's full-fashioned hosiery manufactured from four varieties of long staple American cotton. M. B. Hays, R. E. Rogers, and M. C. Boyer. *Am. Dyestuff Reptr.* **32,** 187–90, 209–11 (Apr. 26, 1943).

Four varieties of long staple cotton were spun into yarns, then knit into women's full fashioned hosiery and subjected to wear and lab. tests. Pima, S × P, and P × (S × P) American-Egyptian cottons from the U. S. Experiment Station at Sacaton, Ariz., were classed as grade 1, 1-9/16 in. staple. A commercially produced

Coker Wilds cotton was classed as Strict Middling of 1–3/8 in. staple. The four cottons were spun under controlled conditions into 90/2 and 120/2 combed yarns with a 3.75 Z twist multiplier in the single and 4.25 S twist multiplier in the ply. The yarns were mercerized and gassed, then knit into women's full fashioned hosiery. The hose were worn by student nurses in a Washington hospital. Samples removed at regular intervals of 6 periods of wear and laundering were subjected to phys. and chem. analyses. The remaining hose were continued in service until worn out. The three American-Egyptian cottons produced stronger yarns and hose with higher bursting strength than did the shorter staple Coker Wilds cotton. The fluidity values showed that all four cottons were of good quality chemically. There was no statistically significant difference in the length of service of hose made from any of the four cottons. However, the hose from the Coker Wilds appeared to be the least satisfactory when the numerical values for the length of service, time of first break in the leg portion, and the percentage of hose without breaks in the leg portion at the time of discard are all considered. And the S × P hose probably would be the most satisfactory. As evaluated by fluidity there was little difference in chem. deterioration among the four cottons. In the Frazier test for elastic properties, the differences between the four cottons were statistically significant but were not of practical importance. Service produced a significant amt. of deterioration in cotton as measured by bursting strength and fluidity. The amt. of deterioration was greater during the first 12 periods of wear than during the second half, the 12th to the 24th period. The variation attributable to individual wearers is significant when evaluated by the sensitive fluidity test.

Plastic Coatings

Plastic coatings in the post-war era. John B. Cleaveland. *Textile World*, **93**, 59–64 (May 1943).

The more important materials that are now being used and will probably be employed for the coating of fabrics in the post-war era are named. The chemical and physical characteristics are detailed, together with their relative suitability for various applications. A table is included which rates various plastic coating materials when applied to textiles, in accordance with their comparative degree of solubility, flexibility, adhesion, heat-sealing ability, and resistance to water, acid, alkali, alcohol, gasoline, flame, heat, cold, sunlight, and tack.

Effect of Storage

Effect of storage on fabrics. Ruth E. Rogers and Margaret Hays. *Text. Research* **13**, No. 6, 20–35 (April 1943).

Cotton sheeting both new and desized, desized linen, and degreased wool were stored in the dark at av. temps. of 78° F. and 102° F. for 4 yrs. The desized cotton and linen and the degreased wool also were stored in diffused light at 78° F. At the lower temp., in the dark, the desized cotton and linen were stored, wrapped and unwrapped, and the wool wrapped. Before storage and at intervals of 6 mths., breaking strength, fluidity, and copper no. detns. were made on the cellulosic materials, and breaking strength, elongation, cystine sulfur, moisture, and methylene blue absorption tests on the wool for all conditions except exposure to diffused light. The deterioration of samples exposed to diffused light was evaluated by fluidity for cotton and linen and by cystine sulfur for wool. Changes in light reflectance were detd. after 2 and 4 yrs. of storage for all the fabrics under all conditions except

exposure to diffused light. No significant differences were found between the values for the wrapped and the unwrapped samples kept in the dark room at room temp. for desized cotton and linen sheetings as measured by breaking strength, copper number, fluidity, and surface reflectance. All tests used in this study showed that both the new and desized cotton sheeting were significantly more deteriorated when stored at the high temp. than at room temp. According to filling breaking strength and copper no., linen stored at the high temp. was significantly more damaged than at the low, but for the other tests on linen stored at the two temps., no difference greater than that due to exptl. error were found. Cystine sulfur, and methylene blue absorption detns. showed that wool stored at the high temp. was more chemically deteriorated than at the low. Significantly greater changes occurred in the new cotton sheeting than in the desized during storage at the high temp., according to all tests. Also during storage at the low temp. the new fabric had a lower breaking strength in both directions than the desized. Storage in diffused light caused significantly more chem. deterioration than storage in the dark at the same temp. according to the fluidity measurement for cotton and linen and to cystine sulfur for wool. Under the conditions of this exp., exposure to diffused light at room temp. produced as much change as exposure in the dark at the high temp. in the case of cotton and wool, whereas for linen diffused light caused more chem. damage than did the high temp. As a result of this study it is recommended that fabrics be stored in the dark, at as low a temp. as convenient, and free of finishing material.

Warmth Without Weight

Warmth without weight. Clifford Kirkpatrick. *Textile Research*, **13**, 16–23 (May 1943).

Effect of the application of metallic coatings to textiles for the purpose of insulating against escape of heat from the body was studied. Comparative tests of reflective and non reflective films were made. Bottles were wrapped and heat losses measured. Losses of body heat were measured by means of anaesthetized cats wrapped in various coverings. It was found: (1) the spraying of a light fabric even on one side only with aluminum paint permits the reduction of body heat loss from 20% to 40%; (2) light weight fabric or paper coated with a reflective film approaches wool fabric in insulation value; (3) a fabric to which a reflective surface is applied may be sufficiently porous to permit the necessary air circulation and evaporation of perspiration and yet have marked insulation value; (4) a fabric with one side more reflective than the other is a better insulator with the brighter surface outside away from the heat radiating body.

Wool as a Processing Agent

Wool as a textile processing agent. Walter Fischer. *Melliand Textilber.* **22**, 482–3 (1941); *Chem. Zentr.* **1942, I**, 291 (through *Chem. Abstr.* 1943, **37**, 2584[3]).

By a careful and thorough degradation of wool or other animal hair at low temps. with dil. $Ba(OH)_2$ solns. a product is obtained which is completely stable on storage and can be used in weak acidic or ammoniacal solns. In dyeing it is useful as a leveling agent for all fibers, increases the color strength and aids in exhausting the bath. It is a good detergent and an excellent fulling agent even when used alone. It has strong foaming properties and can be used with $Al_2(SO_4)_3$ and $NaHCO_3$ to produce a stable foam suitable for fire fighting. Casein, fish meal and similar products yield like substances of lesser activity.